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Plastic Debris in Mangrove Forests; A contemporary Perspective

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Abstract

Plastic pollution in the marine and coastal ecosystems has become a hot theme in the present days, since the input as well as the threats are increasing widely. Almost all the coastal systems like mangroves, seagrasses, and coral reefs are contaminated with plastic debris. Records show that 4.8 to 12.7 metric tons of plastic waste enters into the oceans from the coastal countries because of improper waste management practices.

Introduction

Plastic pollution in the marine and coastal ecosystems has become a hot theme in the present days, since the input as well as the threats are increasing widely. Almost all the coastal systems like mangroves, seagrasses, and coral reefs are contaminated with plastic debris. Records show that 4.8 to 12.7 metric tons of plastic waste enters into the oceans from the coastal countries because of improper waste management practices (Akdogan and Guven, 2019) [1]. The features that made plastics a favourable commodity in daily life had turned it into a global chaos. Wetlands that are either permanently or seasonally inundated by water (Liu et al., 2019) [2], has higher possibilities trapping plastic debris in their ecosystems. Studies have showed the ecological risk imposed by plastic debris to the marine biota [3-5] and as well as the threats to the coastal well-being (Jambeck et al., 2015) [6]. However, what has less emphasized is the impacts brought up due to the presence of plastics in their ecosystems all alone. This paper intends to focus on how mangroves would become a critical victim of the consequences from the plastic debris. Mangroves are a cluster of woody halophytes with amphibian characteristics that dominate the intertidal zones of the tropical regions of the globe. They are highly adapted to the extreme haline and anoxic environments via means of complex root systems that anchor the whole mangrove trees (Alongi and Mukhopadhyay, 2015) [7]. Occurrence of such an extensively developed anchoring system to a mangrove ecosystem have been considered advantageous by the researchers, over decades yet had paved way for the utter possibility for them to trap the plastic debris. This paper convinces that the problem of plastic debris trapping in the mangrove ecosystems; more precisely the mangrove roots is more connected to the tidal action and sediment dynamics occurring in the mangrove ecosystem. Even though the woody halophytes are simpler in architecture as Alongi, 2008 [8] mentions in his studies, the ecological processes driving their hydrogeology happen to exhibit them as more of a complex bionetwork (Figure 1).



Figure 1: Graphical Abstract

This makes it difficult to understand and study the source and fate of the plastic debris in the mangrove ecosystems. In order to comprehend the cycling and trapping of plastic debris in the mangrove trees, it is crucial to understand the sediment dynamics of the ecotone. Unfortunately, there have not many studies undertaken on such a topic; which leads the scientific community to stay put. Sediment dynamics in a mangrove ecosystem is related to the tidal patterns of ebb and flood. A simple understanding is that the sedimentation mechanisms in a mangrove ecosystem is due to the high-micro turbulence generated by the flood around the vegetation maintaining sediment in suspension at flood tidal currents. The sediment settles near or on the high tide zone and not re-entrained by ebb current since the vegetation traps them (Furukawa and Wolanski 1996) [9]. In a polluted environment,



plastic debris are carried along with flood strained in the mangrove vegetation and where they are settled forever. It is arguable that less research input on sediment dynamics in mangrove ecosystem, fate of plastics could not be experimented. However, since both of them are non-overlapping two different agendas and plastics pollution in wetlands is a crucial topic these days and robust research efforts are required for a global management of plastics. This could be initiated with proper understanding of the plastic waste source and possible impacts on the ecosystem health and well-being of human. Despite the barriers and the severity of crisis, there should be vision for optimism. On one side, letting the researchers work on the fate of plastics in mangrove wetlands whilst the public can work on the reducing the input of plastics from the source. Practices like reusing and recycling plastics, using eco-friendly alternatives (like paper and cloth), restraining from activities like dumping solid waste in mangrove wetlands and educating the community about the fact of the global crisis of plastic pollution. Industrialists should be made aware of the acute and chronic consequences of plastic debris on the mangrove ecosystems. On the other hand, we need more scholarly and integrated research protocols that deals with mangrove ecology, plastic enumeration and conservation science; to work on the roots, effects and threats of plastic debris in mangroves, which in turn paves way to effective management protocols. The more we know, the better we can act.

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